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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/894,987	06/27/2001	Mark Ghinovker	KLA1P018	3806

22434 7590 06/22/2005

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EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2623	

DATE MAILED: 06/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/894,987	GHINOVKER ET AL.	
	Examiner	Art Unit	
	Vikkram Bali	2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10-12,14-27,29-34 and 36-50* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,10-12,14-27,29-34,36-50* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment received on 5/2/05 has been entered. And, the action follows:

Response to Arguments

2. Applicant's arguments filed 5/2/05 have been fully considered but they are not persuasive.

Summary of Applicant's Argument: Kaiser and Dirksen are directed at alignment marks, not overlay marks. No portion of the alignment mark is compared to another portion or to another alignment mark to determine alignment of two patterns on the wafer. Also, there is not motivation for combining of Bareket and Dirksen and Kaiser.

Examiner's Response: While Kaiser and Dirksen are directed to alignment marks, they are related to the claimed invention. Dirksen discloses "In-process Image Detecting Technique for Determination of Overlay, and Image Quality for ASM-L Wafterstepper" as related art. Furthermore, comparing a portion of the mark to another portion or to another mark to determine alignment of two patterns on the wafer is not a claimed limitation.

Also, Kaiser, Bareket and Dirksen are combinable because they are from a similar problem solving area of measuring alignment. In the instant case, Bareket does discloses the overlay system (as accepted by the applicant see page 13 paragraph 2, of remarks 5/2/2005), and Kaiser and Dirksen does suggest aligning system in the wafer manufacturing process. Therefore, at the time of the invention, it would have been

obvious to a person of ordinary skill in the art to modify the coarsely segmented elements disclosed by Kaiser and Bareket to include being formed by a plurality of finely segmented elements. The motivation for doing so would have been to increase the accuracy and the reliability of the system by providing smaller measurement marks. Therefore, it would have been obvious to combine Kaiser and Bareket with Dirksen to obtain the invention as specified in claim 1.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 31-34 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bareket (EP 0818814), and further in view of Dirksen et al. (5,674,650).

Regarding claim 31, Bareket discloses capturing an image of an overlay mark formed on the substrate (Figure 2; Col. 5, lines 33-54), the overlay mark having a plurality of working zones each of the working zones including a periodic structure of coarsely segmented elements (Figure 1b), selecting a plurality of working zones from the captured image, wherein at least one working zone from each layer is selected (Col. 2, lines 1-16; Col. 4, lines 35-57) forming representative signals for each of the selected

working zones, wherein at least one signal for each layer is formed (Col. 8, lines 7-58, Col. 9, lines 1-7), and comparing the signal from a first layer to a signal from a second layer to determine the relative shift between different layers (Abstract; Col. 9, lines 18-58, Col. 10, lines 1-79).

Bareket discloses including coarsely segmented elements (Figure 1b), but does not appear to recognize including coarsely segmented elements formed by a plurality of finely segmented elements. However, Dirksen et al. ("Dirksen") discloses providing coarsely segmented elements (Figure 6a) formed by a plurality of finely segmented elements (Figure 6c). Bareket and Dirksen are combinable because they are from a similar problem solving area of measuring alignment. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the coarsely segmented elements disclosed by Bareket to include being formed by a plurality of finely segmented elements. The motivation for doing so would have been to increase the accuracy and the reliability of the system by providing smaller measurement marks. Therefore, it would have been obvious to combine Bareket with Dirksen to obtain the invention as specified in claim 31.

Regarding claim 32, Bareket discloses forming representative signals by collapsing 2D images of the working zones into 1D signals by averaging over X for Y-overlay calculations and by averaging over Y for X-overlay calculations (Col. 9, lines 34-58, Col. 10, lines 1-19).

Regarding claim 33, Bareket discloses comparing the signal from a first layer to a signal from a second layer to determine the relative shift between different layers via a cross correlation, or covariance-based, overlay algorithm (Col. 9, lines 34-56).

Regarding claim 34, Bareket discloses comparing the signal from a first layer to a signal from a second layer to determine the relative shift between different layers via a cross correlation, or covariance-based, overlay algorithm (Col. 9, lines 34-56). Bareket further discloses that it is also known to use a Fourier Decomposition overlay algorithm (Col. 9, lines 34-56). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to compare the signals using a Fourier Decomposition overlay algorithm. Applicant has not disclosed that using a Fourier Decomposition overlay algorithm provides an advantage, is used for a particular purpose, or solves a stated problem. One of ordinary skill in the art, furthermore, would have expected Applicant's invention to perform equally well with either overlay algorithm because both overlay algorithms perform the same function of comparing two signals to determine the relative shift between the different layers. Therefore, it would have been obvious to one of ordinary skill in the art to modify Bareket to obtain the invention as specified in claim 34.

Regarding claim 42, the arguments analogous to those presented above fro claim 31 are applicable to claim 42. Dirksen discloses the finely segmented elements are configured to mimic one or more features formed on the substrate with the finely segmented elements (Figure 6c).

8. Claims 30, 40, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cresswell et al. (5,617,340) in view of Dirksen et al. (5,674,650).

Regarding claim 30, Cresswell et al. discloses a test region positioned on a first layer of a substrate (Figure 1), the first layer being formed by a first pattern via a first process and a second pattern via second process (Col. 8, lines 12-62), a plurality of working zones positioned in the test region (Figure 1), the working zones representing the actual areas of the test region that are used to determine the relative shift between the first and second patterns (Col. 8, lines 63-67, Col. 9, lines 1-21), wherein a first portion 22, 24, 26 of the working zones are formed via the first process and a second portion 28, 30 of the working zones are formed via the second process (Figure 2a-c), and a periodic structure positioned within each of the working zones, each of the periodic structures including a plurality of coarsely segmented elements (Figure 1, Figure 2a-c). Cresswell et al. does not appear to recognize including coarsely segmented elements formed by a plurality of finely segmented elements. However, Dirksen et al. ("Dirksen") discloses providing coarsely segmented elements (Figure 6a) formed by a plurality of finely segmented elements (Figure 6c). Cresswell et al. and Dirksen are combinable because they are from a similar problem solving area of measuring alignment. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the coarsely segmented elements disclosed by Cresswell et al. to include being formed by a plurality of finely segmented elements. The motivation for doing so would have been to increase the accuracy and the reliability of the system by providing smaller measurement marks. Therefore, it would have been

obvious to combine Cresswell et al. with Dirksen to obtain the invention as specified in claim 30.

Regarding claim 40, the arguments analogous to those presented above for claim 30 are applicable to claim 40. Dirksen discloses the finely segmented elements are configured to mimic one or more features formed on the substrate with the finely segmented elements (Figure 6c).

Regarding claim 41, Cresswell discloses the first portion of the working zones have at least two working zones diagonally opposed and spatially offset relative to one another, and the second portion of the working zones having at least two working zones diagonally opposed and spatially offset relative to one another, the first and second portions of the working zones lying crosswise relative to each other (Figures 1 and 2a-c). Note, structures 12 (Figure 1) may be composed of patterns as shown in Figures 2a-c (Col. 8, lines 23-26). Using two sites 14 lying crosswise relative to each other (Figure 1) as a first and second portion each having at least two working zones 12 diagonally opposed and spatially offset relative to one another, Cresswell meets the limitations specified in claim 41.

9. Claims 1-8, 10-12, 14-27, 29, and 36-39 and 48-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaiser (US 5,172,190) in view of Bareket (EP 0818814) and further in view of Dirksen et al. (US 5,674,650).

Regarding claim 1, Kaiser discloses at least one test pattern for determining the relative shift between a first and a second layer in a first direction (Col. 2, lines 1-14), the test pattern having a first set of working zones 2M and 3M (Figure 1) and a second

set of working zones 1W and 4W (Figure 2), the first set being disposed on a first layer and having at least two working zones diagonally opposed and spatially offset relative to one another (Figure 1; Col. 1, lines 56-59), the second set being disposed on a second layer and having at least two working zones diagonally opposed and spatially offset relative to one another (Figure 2; Col. 1, lines 60-65). Kaiser discloses including a periodic structure positioned within each of the working zones, each of the periodic structures including a plurality of coarsely segmented elements (Figures 1 and 2). Kaiser discloses the two layers being a mask and a wafer. Kaiser does not appear to disclose successive layers of a substrate. However, Bareket discloses determining the relative shift between successive layers of a substrate (Abstract) using a test pattern with a first set of working zones disposed on a first layer 60a and 60b and a second set 70a and 70b being disposed on a second layer (Figure 3; Col. 4, lines 35-57). Kaiser and Bareket are combinable because they are from a similar problem solving area of determining an alignment between two objects. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have modified the layers disclosed by Kaiser to include successive layers of a substrate. The motivation for doing so would have been because it expands the versatility of the system to include determining the alignment of layers of a substrate.

Kaiser and Bareket do not appear to disclose the plurality of coarsely segmented elements are formed by a plurality of finely segmented elements. However, Dirksen et al. ("Dirksen") discloses providing coarsely segmented elements (Figure 6a) formed by a plurality of finely segmented elements (Figure 6c). Kaiser, Bareket and Dirksen are

combinable because they are from a similar problem solving area of measuring alignment. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the coarsely segmented elements disclosed by Kaiser and Bareket to include being formed by a plurality of finely segmented elements. The motivation for doing so would have been to increase the accuracy and the reliability of the system by providing smaller measurement marks. Therefore, it would have been obvious to combine Kaiser and Bareket with Dirksen to obtain the invention as specified in claim 1.

Regarding claim 2, the arguments analogous to those presented above for claim 1 are applicable to claim 2. Bareket discloses an image of the test pattern is captured via an imaging tool and an analysis algorithm is used to calculated the relative displacement of the working zones from the captured images (Figure 2).

Regarding claim 3, Kaiser discloses the first set of working zones is angled relative to the second set of working zones (Figures 1 and 2).

Regarding claim 4, Kaiser discloses the working zones are positioned within a perimeter of the mark (Figures 1 and 2).

Regarding claim 5, Kaiser discloses the working zones are positioned within a perimeter of the mark (Figures 1 and 2). Kaiser discloses capturing an image of the areas to be evaluated (Col. 2, lines 1-14). While Kaiser does not expressly state the perimeter of the mark corresponds to the optical perimeter of the field of view of the metrology tool used to image the overlay mark, the field of view defining the area available for capturing an image via the metrology tool, this is a well known

methodology routinely implemented in the art. It would have been obvious to one of ordinary skill in the art to specify the size of the mark being imaged corresponds to the field of view of the camera.

Regarding claim 6, Kaiser discloses the working zones substantially fill the perimeter of the mark (Figures 1 and 2).

Regarding claim 7, Kaiser discloses the working zones are spatially separated from one another so that they do not overlap portions of an adjacent working zone (Figures 1 and 2).

Regarding claim 8, Kaiser discloses the working zones have identical size and shape (Figures 1 and 2), thereby configured to diminish the impact of non-uniformities across the mark on tool and wafer induced shifts.

Regarding claim 10, Kaiser discloses including a periodic structure positioned within each of the working zones, each of the periodic structures including a plurality of coarsely segmented elements (Figures 1 and 2). Kaiser discloses that different line densities and widths in the alignment marks can be used (Col. 2, lines 66-67, Col. 3, lines 1-2). Kaiser does not appear to disclose the pitch, period, and duty cycle of the coarsely segmented elements are configured to balance the resolution of the metrology used to image the overlay mark and the robustness of the process used to form the layers. However, Bareket (EP 0818814) discloses that the number of lines used is dependent on the resolution required and the signal-to-noise ratio that must be overcome. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the configuration of the pitch, period, and duty

cycle of the coarsely segmented elements disclosed by Kaiser to specify balancing the resolution of the metrology used and the robustness of the process used because it is well known in the art and increases the resulting accuracy of the measurements.

Regarding claim 11, Kaiser discloses the coarsely segmented elements are parallel lines (Figures 1 and 2).

Regarding claim 12, the arguments analogous to those presented above for claim 1 are applicable to claim 12. Bareket discloses the relative shift between the first and second layers of a wafer is determined by comparing the relative positions of periodic structures on different layers (Abstract; Figure 3; Col. 4, lines 35-57).

Regarding claim 14, the arguments analogous to those presented above for claim 1 are applicable to claim 14. Dirksen discloses finely segmented elements that are configured to provide shift information that more closely matches the relative shift between patterns of an IC formed on each of the two layers of the substrate (Figure 6c).

Regarding claims 37 and 38, the arguments analogous to those presented above for claim 1 are applicable to claims 37 and 38. Dirksen discloses the dimensions of the finely segmented elements are similar to the dimensions of one or more device features of the IC and the feature size and pitch of the finely segmented elements are substantially equal to the feature size and pitch of the device features (Figure 6c; Col. 7-8).

Regarding claim 15, the arguments analogous to those presented above for claim 1 are applicable to claim 15. Bareket discloses a second test pattern for

determining the relative shift between a first and second layer of the substrate in a second direction (Figure 1b; Figure 3; Col. 4, lines 35-57).

Regarding claim 16, Bareket discloses the second test pattern is orthogonal to the first test pattern (Figure 1b).

Regarding claim 17, Bareket discloses the first direction corresponds to the X-direction and the second direction corresponds to the Y-direction (Figure 1b).

Regarding claim 18, Bareket discloses a third test pattern and a fourth test pattern for determining the relative shift between a first and a second layer of substrate in the first and second directions, respectively (Figure 1b).

Regarding claim 19, the arguments analogous to those presented above for claim 1 are applicable to claim 19. Bareket discloses the first layer is disposed directly above or below the second layer (Col. 4, lines 35-57; Abstract).

Regarding claim 36, the arguments analogous to those presented above for claim 1 are applicable to claim 36. Dirksen discloses the finely segmented elements are symmetrically positioned within the coarsely segmented elements of the periodic structures (Figure 6c).

Regarding claim 20, the arguments analogous to those presented above for claim 1 are applicable to claim 20. Kaiser further discloses the periodic structure of coarsely segmented elements positioned in the working zones of the first set, 2M and 3M (Figure 1), and the second set, 1W and 4W (Figure 2), are oriented in a first direction, Y-direction, and the second set of working zones is positioned crosswise relative to the first set of working zones (Figures 1 and 2).

Regarding claims 21- 27 and 29, the arguments analogous to those presented above for claims 5-8, 10-12, and 14 are applicable to claims 21- 27 and 29, respectively.

Regarding claim 39, the arguments analogous to those presented above for claim 20 are applicable to claim 39. Dirksen discloses the finely segmented elements are configured to mimic one or more features formed on the substrate with the finely segmented elements (Figure 6c).

Regarding claims 48-50, Dirksen further teaches the finely segments are with the coarsely segmented elements and are evenly across the coarsely segments, (see figure 6a and 6c), as claimed.

10. Claims 43-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dirksen et al. (US 5,674,650) in view of Cresswell et al. (US 5,617,340).

Regarding claim 43, Dirksen et al. ("Dirksen") discloses a multidirectional test pattern for determining the overlay between a first and second layer, the pattern being separated into four quadrants (Figure 2), each of the four quadrants including at least two working zones that are juxtaposed relative to one another and that together substantially fill the quadrant, the upper left quadrant (P1,b) including working zones configured to provide overlay information in a first direction, the upper right (P1,a) quadrant including working zones configured to provide overlay information in a second direction that is different from the first direction, the lower right quadrant (P1,d) including working zones configured to provide overlay information in the first direction, and the lower left quadrant (P1,c) including working zones configured to provide overlay

information in the second direction. Dirksen does not appear to disclose separately generating the working zones that are juxtaposed relative to one another. However, Cresswell et al. ("Cresswell") discloses that it is known to separately generate working zones that are used to determine the overlay between two separately generated patterns on a substrate (Col. 8, lines 12-67, Col. 9, lines 1-21; Figures 1 and 2a-c). Dirksen and Cresswell are combinable because they are from a similar problem solving area of measuring alignment. At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the working zones disclosed by Dirksen to include separately generating the working zones. The motivation for doing so would have been to enable analysis of overlay measured to differentiate the contributions of mask misalignment errors and mask patterning errors to the total overlay (Col. 7, lines 1-16). Therefore, it would have been obvious to combine Dirksen with Cresswell to obtain the invention as specified in claim 43.

Regarding claim 44, Dirksen discloses the working zones include a periodic structure comprised of a plurality of coarsely segmented lines that substantially fill the perimeter of its corresponding working zone (Figure 2).

Regarding claim 45, Dirksen discloses the coarsely segmented lines of the periodic structures located within juxtaposed pairs of working zones are aligned with one another (Figure 2).

Regarding claim 46, Dirksen discloses the coarsely segmented lines are formed from a plurality of finely segmented elements configured to mimic one or more device features formed on the substrate with the finely segmented elements, the finely

segmented elements being symmetrically positioned within each of the coarsely segmented lines (Figure 6).

Regarding claim 47, Dirksen discloses the working zones located closer to a center of the overlay mark are generated concurrently and the working zones located further from the center of the overlay mark are generated concurrently (Figure 2).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vikkram Bali whose telephone number is 571.272.7415. The examiner can normally be reached on 7:00 AM - 3:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on 571.272.7414. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Vikkram Bali
Primary Examiner
Art Unit 2623

vb
June 16, 2005